SECTION 8

SUBGRADE DESIGN REQUIREMENTS

Original Ordinance Number: 06-03-20

SECTION 8 – SUBGRADE DESIGN REQUIREMENTS

ENGINEERING DESIGN AND CONSTRUCTION PROTOCOL for Pavements within the Eagle Ford formation in the City of Frisco. (The Eagle Ford formation is defined as an area with eastern limits generally following Preston Road and extending to the western city limits.)

8.01 GENERAL:

All pavement projects shall have a subgrade investigation and pavement design. This protocol provides for two methods: the Swell Test Alternative and the calculated Potential Vertical Rise (PVR) - TxDOT Tex-124-E Alternative. The information and recommendations contained in the report must be approved in writing by the Engineer[1]. As a minimum, the investigation shall consist of:

A. Field Investigation

1.1. (Swell Test Alternative) Borings shall be drilled on center of roadway at 250 feet spacing (or less), alternating between each roadway direction or on a 200 feet grid throughout a subdivision to a depth of at least 10 feet below finished subgrade.

1.2. (PVR-TxDOT Tex-124-E Alternative) Borings shall be drilled on center of roadway at 250 feet spacing (or less), alternating between each roadway direction or on a 200 feet grid throughout a subdivision to a depth of at least 20 feet below finished subgrade.

2. Borings shall be sampled at 3 feet intervals or less to a depth of 10 feet and at 5 feet intervals or less thereafter.

3. Bulk samples of each soil type encountered in the upper 5 feet shall be taken.

4. Logs shall be developed to provide a lithographic log of the soil types encountered in each boring, descriptions of each layer and groundwater conditions.

B. Determination of swell characteristics and movement potential can be accomplished by either the Swell Test Alternative (C.1.1) or calculated Potential Vertical Rise (Alternative C.1.2) for a 20 foot depth of moisture penetration at the option of the Design Engineer[2]. The Design Engineer shall submit all calculations and assumptions involved in calculating the PVR and the recommended depth of moisture treatment to the City for review.

C. Laboratory Investigation

1. Soil types in each boring shall be subjected to classification tests; Atterberg limits (ASTM D 4318) and Percent Passing the No. 200 sieve (ASTM D 1140) and moisture/density. Where logs show uniform conditions, the number of tests can be reduced by visual classification, as long as there is at least one set of classification tests per each 2 borings.

1.1. (Swell Test Alternative) Test for swell potential using ASTM D 4546 at 200 psf stress at least two (2) samples per boring at varying depths from 0 to 10 feet to determine with reasonable certainty the average swell potential of the subgrade.

1.2. (PVR-TxDOT Tex-124-E Alternative) Test for swell potential using swell tests (ASTM D4546) and/or soil suction tests (ASTM D5298) necessary to calculate PVR for a 20 foot moisture penetration.

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[1] The term "Engineer" as used in these specifications shall mean the City of Frisco Director of Engineering Services or his/her designee.

[2] The term "Design Engineer" as used in these specifications shall mean an individual or entity with whom the Owner has entered into an agreement for professional geotechnical engineering services.

2. Due to the variability in moisture contents over the year, the Design Engineer shall assess the condition of the samples and the season. Moisture Content Tests (ASTM D 2216) shall be performed. When in the Design Engineer's opinion the samples are wetter than should normally be expected, the samples shall be air dried such that the samples represent the drier portion of the year.

3. Average all swell test results to determine the mean maximum swell percentage and the standard deviation. In the months of June through September use the mean swell percentage. For all other time periods use the mean plus one standard deviation to determine the design swell percentage.

4. Test for sulfates in the upper 3 feet of the subgrade in each boring using EPA 9038 or EPA 375.4 with 10:1 dilution ratio. Provide sufficient testing to determine with reasonable certainty the levels of sulfate present. Note: Majority of testing should be performed in the light brown clays.

5. Based upon the results of classification tests, group the samples and identify the subgrade soil types in the upper 5 feet which impact the pavement design.

6. Perform a lime stabilization series for each soil type expected to be in the upper 12 inches of the subgrade[3]. The Eades-Grimm method of pH testing shall be used to obtain a beginning point. Additional testing shall be performed for each soil type to determine lime content. Minimum Design Criteria are:

    a. pH = 12.4 after mellowing (ASTM D 2976)
    b. Swell potential <1.0 percent under 200 psf stress test[4] (ASTM D 4546)
    c. Unconfined Compressive strength >160 psi[4] (ASTM D 2166)

    The minimum lime content shall be the percentage, by weight, of hydrated lime required to meet the Minimum Design Criteria plus 1.0%.

7. Light brown clays having over 5,000 ppm (0.5 percent) sulfate, dark brown clays having over 25,000 ppm (2.5 percent) sulfate, and weathered shale having over 15,000 ppm (1.5 percent) sulfate shall be stabilized using double application method.

8.02 ENGINEERING AND CONSTRUCTION:

The Design Engineer shall utilize the results of the field and laboratory investigation to provide an engineered pavement section consisting of moisture treated subgrade, lime stabilized subgrade and continuously reinforced concrete. The continuously reinforced pavement shall consist of City of Frisco standard sections for the street classification or based on rigid pavement design in accordance with The City of Frisco "Thoroughfare and Circulation Design Requirements." The following engineering requirements will apply to the design and report.

A. Weathered shale material encountered within 8 feet below finish subgrade shall be subexcavated to a depth of at least the depth of required moisture treatment and replaced with on-site light brown or dark brown clays or other approved material.

B.1 (Swell Testing Alternative) Use **Figure 8.1** to determine the minimum depth of moisture treatment based on average swell potential percentage to 10 feet (mean plus one standard deviation) and anticipated speed limit.

B.2 (PVR-TxDOT Tex-124-E Alternative) The Design Engineer shall calculate the PVR based upon a 20 feet moisture penetration and shall provide moisture treatment depth to limit the PVR to 4.5 inches. The Design Engineer shall submit all calculations and assumptions involved in calculating the PVR and the recommended depth of moisture treatment to the City for review.

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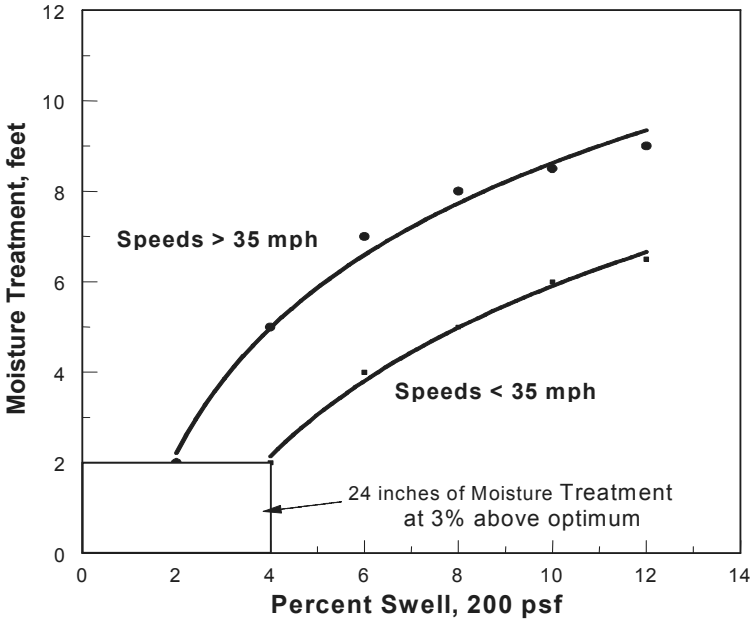
[3] Note: The minimum lime percentage shall be 7.0 percent hydrated lime for light brown clays and 10.5 percent hydrated lime for dark brown clays. The weathered shale is not suitable for stabilization without permission from the Engineer and appropriate detailed engineering and laboratory design.

[4] Soil mixed with lime at +3% of its optimum moisture content, with 2 days of mellowing time, remolded to 95% ASTM D 698. Cure remolded samples @ 100°F for 5 days, then followed by capillary soak for 24 hours for unconfined compression test. The lime source used in the laboratory design shall be specified for use in the field construction.

FIGURE 8.1 - RECOMMENDED DEPTH OF MOISTURE



C. Moisture treatment to a minimum of 3 percentage points above optimum moisture content at a minimum of 95 percent standard Proctor (ASTM D 698) shall be required for at least 2 feet of the subgrade. Thicker zones of moisture treatment may be required depending upon the average swell potential. The thickness shall be determined in accordance with **Figure 8.1** or as determined by calculations from B.2**.**

D. Trench backfill shall consist of clay soils and shall be placed in thin, loose lifts, moisture conditioned to a minimum of 3 percentage points above optimum moisture content, and compacted to a minimum of 95 percent of standard Proctor (ASTM D 698) maximum dry density. Sands containing less than 20% passing the No. 200 sieve shall be placed in thin, loose lifts and moisture conditioned to within 2 percentage points of optimum moisture content and compacted to a minimum of 95 percent of standard Proctor (ASTM D 698). The placement and compaction of trench backfill shall be observed and density tested during construction.

E. The upper 8 inches (residential) to 12 inches (arterial) of the subgrade shall be lime stabilized in accordance with the laboratory determined lime percentage and shall meet the requirements listed above in Item C.6. The lime stabilized subgrade shall be moisture treated to a minimum of 4 percentage points above optimum moisture content, allowed to mellow before final compacting to a minimum of 95 percent standard Proctor (ASTM D 698) at a minimum of 2 percentage points above optimum moisture content.

F. Moisture treatment and lime stabilization shall extend at least four feet beyond the edge of pavement. A moisture barrier consisting of at least 10 mil poly sheeting shall be placed horizontally on the subgrade beyond the pavement edge and extend at least 6 feet on either side of the pavement neat line after final compaction. The barrier shall be covered with at least 8 inches of lightly compacted soil. Care should be taken not to rip or tear the poly sheeting during placement of the cover fill.

G. The thickness and reinforcement shall be the greater of either the City of Frisco design standards or a design signed and sealed by a qualified Professional Engineer in accordance with an approved design methodology such as AASHTO for continuously reinforced concrete pavements. All calculations and assumptions used by the Design Engineer shall be provided to the Engineer for review.

H. Stabilized subgrade soils shall be subjected to testing to determine Resilient Modulus (M_R). The testing can be either direct M_R testing or use of correlation testing methods which are accepted by the City of Frisco.

I. All concrete, which comes into contact with soils containing more than 0.1% (1,000 ppm) sulfate shall be designed to resist sulfate attack. As a minimum, the concrete shall have a maximum water/cementitious materials ratio of 0.45, with 25% ASTM C 618 Class F fly ash and ASTM C 150 Type II cement (or Type V).

J. Detailed mix design shall be performed for concrete pavement in high sulfate areas.

K. Finished pavement grades shall have at least 0.8 percent longitudinal slope to provide for drainage in the event that isolated heave features occurred.

L. Results of the field and laboratory investigations, engineering analyses and recommendations shall be presented in a report and is subject to the approval of the Engineer. The report shall contain a specific list of design thicknesses, reinforcement, subgrade and stabilization requirements including lime source, type, and concentration (by dry weight) which can be easily incorporated to plans and specifications. All calculations and laboratory tests shall be included in the report along with boring location plan and geology maps. The report shall be signed and sealed by a qualified Professional Engineer.

8.03 LIME STABILIZATION OF SUBGRADE SOILS:

A. SCOPE:

This Item shall govern stabilization of the new or existing subgrade and shall consist of all labor, equipment and material necessary to pulverize the subgrade clays or existing pavements, add the specified percentage of hydrated lime, mix, mellow, remix and compact the mixture as specified in this Item. The Contractor[5] shall be responsible for making allowances for subgrade bulking during stabilization to achieve design finished subgrade elevation and meeting specified thickness. The finished item shall be a compacted and finished subgrade meeting the grades, thicknesses, lines and typical cross sections shown on the plans and specifications and having:

1. A minimum unconfined compressive strength of 160 psi (ASTM D 2166 / AASHTO T 208 or ASTM D 1633 / AASHTO T 220), (information only)
2. Less than 1 percent swell when tested under a 200 psf stress (ASTM D 4546 / AASHTO T 216),
3. A minimum pH of 12.4 (ASTM D 2976 / AASHTO T 289)

B. MATERIALS:

All materials used in the construction shall meet the following requirements. In the event the Contractor wishes to use materials not listed in this section, the Contractor shall submit to the Engineer mix design data and proof of performance data as required by the Engineer who shall review the submittal and determine whether the materials will meet the design intent. No other materials shall be used without the written permission of the Engineer.

1. Lime – The lime shall meet the requirements of ASTM C977 / AASHTO M 216; contain at least 92 percent calcium and magnesium oxide, and the rate of slaking test for moderate reactivity per ASTM C110 / AASHTO T 232. All lime shall come from a single source, shall be the same source as used in the design, and shall be subject to periodic testing to confirm properties. Each shipment of lime shall be accompanied by a Certificate of Compliance stating the conformance of the product to these specifications. Certificates shall be provided to the Engineer.

   In the event the Contractor changes lime sources, no work shall be done until the Engineer accepts, in writing, a new lime-soil mix design using the new lime source.

[5] The term "Contractor" as used in these specifications shall mean an individual or entity with whom the Owner has entered into an agreement for construction services.

2. Water – Water used for slaking, mixing or curing shall be free of oil, salts, acid, alkali, sugar, vegetable, or other deleterious substances which may cause damage to the finished product. All water shall meet the material requirements AASHTO T 26. Known potable water may be used without testing.

3. Soil – Subgrade soils used in the stabilization shall be of the same AASHTO or ASTM classification and Plasticity Index range as used in the approved mix design. All organics, roots and deleterious materials shall be removed from the area to be stabilized and shall be wasted. The condition of the subgrade soils must be approved by the Engineer prior to beginning work.

4. Asphalt – Asphalt used to seal the surface of the lime stabilized subgrade shall be CSS1h or other approved asphalt as approved by the Engineer and shall conform to the requirements of TxDOT Item 300, "Asphalts, Oils and Emulsions". Each shipment shall be accompanied by a Certificate of Compliance stating the conformance of the product to these specifications which shall be provided to the Engineer.

5. Submittals – At least 30 days prior to commencing lime stabilization work, the Contractor shall furnish the following information to the Engineer:

    a) The proposed source and supplier of lime.
    b) Description of the proposed construction equipment, construction methods, expected production rates and planned sequence of lime stabilization of subgrade.
    c) A lime/on-site soil mix design in accordance with Eades-Grim Method. Design shall comply with the following requirements:
        1) Minimum pH: 12.4 (ASTM D 2976 / AASHTO T 289) after completion of initial mixing with lime at ambient temperature.
        2) Swell Potential: Less than 1.0 percent, in accordance with ASTM D 4546 / AASHTO T 216 at 200 psf stress.
        3) Minimum Unconfined Compressive Strength: 160 psi in accordance with ASTM D 2166 / AASHTO T 208 or ASTM D 1633 / AASHTO T 220.

    The approval of the lime-soil mix design shall be at the discretion of the Engineer. Once the design is approved in writing, the mix design shall be incorporated into these specifications by reference.

    During lime stabilization work, the Contractor shall furnish the following information to the Engineer at the end of each day:

    a) Certified truck weight tickets of lime, delivered to or used at the site.
    b) A summary of the amount of lime used each day, areas stabilized with lime and first mixed, areas second mixed, completed, and areas with curing completed

C. EQUIPMENT:

The machinery, tools and equipment necessary for proper prosecution of the work on this Item shall be on the project and approved by the Engineer prior to beginning this Item. All machinery, tools and equipment used shall be maintained in a satisfactory working condition.

1. Lime Storage – Lime shall be suitably stored in closed, weatherproof containers until immediately before use. Storage bins, when used, shall be completely enclosed.

2. Lime Weight Verification – When lime is furnished in trucks, the weight of lime shall be determined on certified scales or the Contractor shall provide a set of standard platform truck scales at a location approved by the Engineer. Scales shall conform to the requirements of TxDOT Item 520, "Weighing and Measuring Equipment".

3. Slurry Equipment – Quick lime used to manufacture slurry on the project, or other location approved by the Engineer shall be slurried in agitated slurry tanks. The slurrying of Quick lime must be handled in such a way as to not generate any dust hazardous to job personnel or to the public or be potentially damaging to any adjacent property.

4. Distributor Trucks – The distributor truck used for slurry placing shall be equipped with an agitator and a calibrated measuring device or as approved by the Engineer and shall be in good working order. The Contractor shall provide to the Engineer the spread rate calibration (or other acceptable means to calculate the spread rate) prior to use of the equipment.

5. Mixers – Mixers shall be of appropriate size and capacity so as not to delay the project and shall be capable of pulverization to these specifications and mixing of the product.

6. Compaction Equipment – Finishing equipment shall consist of smooth steel wheel vibratory compactors or pneumatic tired roller compactors having a minimum tire pressure of 90 psi. Other types of compaction equipment may be approved at the sole discretion of the Engineer.

D. CONSTRUCTION METHODS:

The completed course shall be uniformly stabilized, free from cracks, loose or segregated areas, of uniform density and moisture content, well bound for its full depth and shall have a smooth surface.

1. Preparation of Subgrade – Prior to stabilization the subgrade shall be compacted and shaped to conform to the typical sections, as shown on the plans with allowances made for bulking of the subgrade. The subgrade shall be moisture treated to the lines and grades shown on the plans and as provided for in the pavement design report. The minimum moisture content shall be 3 percentage points above standard Proctor optimum (ASTM D698) with compaction to at least 95%. If the Contractor elects to use a cutting and pulverizing machine that will process the material to the plan depth, the Contractor will not be required to excavate to the secondary grade or windrow the material. This method will be permitted only if a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a uniform surface over the entire width of the cut. The machine shall provide a visible indication of the depth of cut at all times.

   In lieu of using the cutting and pulverizing machine, the Contractor shall excavate and windrow the material to expose the secondary grade to the typical sections, lines and grades as shown on the plans and as established by the Design Engineer.

2. Pulverization – The existing pavement or base material shall be pulverized or scarified so that 100 percent shall pass the one (1) inch sieve.

3. Application – The design percentage by weight or pounds per square yard of lime to be added will be as shown on the plans and may be varied by the Engineer if conditions warrant. Only two application methods are acceptable; dry application of pebble quick lime or slurried hydrate or quick lime. The rate of application shall be verified using the methods provided in ASTM D 3155.

   Dry quick lime shall be spread only on that area where the mixing operations can be completed during the same working day. Slurried quick lime shall be spread and mixed within 1 hour. Slurry exposed to the air for over 1 hour shall not be accepted for payment.

   Unless otherwise approved by the Engineer, the lime operation shall not be started when the air temperature is below 40º F and falling, but may be started when the air temperature is above 35º F and rising. The temperature will be taken in the shade and away from artificial heat. Lime shall not be placed during periods of rain or when weather conditions in the opinion of the Engineer are not suitable.

   CAUTION: Use of quick lime can be dangerous. Users should be informed of the recommended precautions in handling, storage and use of quick lime.

   a) Dry Placement – Pebble quick lime shall be distributed by a spreader approved by the Engineer. The lime shall be distributed at a uniform rate to achieve the mix design lime content and in such a manner as to reduce the scattering of lime by wind. Lime shall not be applied when wind

conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to adjacent property owners or dangerous to traffic. The material shall be sprinkled as approved by the Engineer.

b) Slurry Placement – Lime Slurry shall be delivered to the project in slurry form at or above the minimum lime concentration as listed in the approved mix design. The residue or "stones" remaining in the tank from the slurrying procedure shall be spread uniformly over the length of the roadway currently being processed, or wasted, unless otherwise approved by the Engineer. Slurry shall be of such consistency that it can be applied uniformly without difficulty.

4. Initial Mixing – The mixing procedure shall be the same for "Dry Placement" or "Slurry Placement" as herein described. The soil and lime shall be thoroughly mixed by equipment approved by the Engineer. A minimum of 4 passes of the mixer is required. The soil and lime mixture shall be brought to a moisture content at least four (4) percentage points above the design optimum moisture content and shall be left to mellow for three (3) days or longer as required by the approved mix design. The mixing shall continue until a homogeneous friable mixture of material and lime is obtained. The mixture shall have a minimum pH 12.4 (additional lime shall be required to meet this specification).

   Following mixing, a sample of the material at the design moisture will be obtained for pulverization testing. All non-slaking aggregates retained on the ¾-inch sieve will be removed from the sample. The remainder of the material shall meet the following pulverization requirement when tested by Test Method Tex-101-E, Part III:

   Minimum passing 1" sieve……100 percent
   Minimum passing No. 4 sieve……60 percent

   The mixture shall be sprinkled and mixed during the mellowing process as required to assist in the chemical reaction. Moisture contents shall remain above optimum for the entire mellowing period.

   Where measured sulfate levels in the light brown clay of the Eagle Ford formation exceed 0.5 percent and a double lime application is required, the mellowing period shall be extended for at least 5 days or as indicated in the mix design, whichever is longer.

5. Final Lime Mixing – After the required mellowing period the second lime application, if required, shall be made. Upon approval by Engineer, the material shall be uniformly mixed by the approved methods. If the mixture contains clods, they shall be reduced in size by approved pulverizing methods so that the remainder of the clods shall meet the following requirements (visual observation, not testing, required):

   Minimum passing 1" sieve……100 percent
   Minimum passing No. 4 sieve……60 percent

   At final mixing, the lime, water content and pH for each course of subgrade stabilization shall conform to the following:

   Lime……+1.0 percent above design percentage based on dry unit weight of soil
   Water….+2 percentage points above optimum moisture content
   pH……12.4

   Samples shall be taken at random locations by a qualified geotechnical testing laboratory selected by the Owner and approved by the Engineer per the testing schedule shown in Section 6 or more frequently.

6. Compaction Methods – Compaction of the mixture shall begin immediately after the requirements listed above in 8.04.D.5 are met. NOTE: Where double mixing is required by the mix design, the required additional lime shall be added and the mixture shall be moisture conditioned and pulverized.

Compaction shall continue until the entire depth of the mixture is uniformly compacted to a minimum of 95 percent of standard Proctor density[6] (ASTM D698) at a minimum of 2 percentage points above optimum moisture content.

All irregularities, depressions, or weak spots which develop as determined by the Engineer shall be corrected immediately by scarifying the areas affected, adding or removing materials as required, and reshaping and recompacting by moisture conditioning and rolling. The surface of the course shall be maintained in a moist, smooth condition, free from undulations, ruts and cracking, until other work is placed thereon or the work is accepted.

In addition to the requirements specified for density, the full depth of the material shown on the drawings shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests will be made by the geotechnical testing laboratory and submitted to the Engineer. If the material fails to meet the density requirements, it shall be reworked to meet the requirements. Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and shall conform with the typical section shown on the drawings and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course or pavement is placed, it shall be recompacted and refinished at the entire expense of the Contractor.

When shown on the plans or approved by the Engineer, multiple lifts will be permitted.

7. Finishing and Curing – After the final layer or course of lime-stabilized subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling with a pneumatic or other suitable roller sufficiently light to prevent hair line cracking. The finished surface shall not deviate by more than 0.04 feet (0.5 inch) from the actual finish grade. Any variations in excess of this tolerance shall be corrected by the Contractor, at the Contractor's entire expense immediately prior to placement of the next paving course, in a manner satisfactory to the Engineer.

   The completed section shall be moist-cured until a non-yielding surface is obtained to support construction traffic and the next layer of the pavement is constructed, as approved by the Engineer.

   In the event the surface cannot be covered by the next layer of pavement or be kept moist, an asphalt membrane shall be applied at the rate of 0.25 gallons per square yard. The Contractor shall protect the membrane from traffic and contamination until the next layer of the pavement system is placed. The addition of a membrane is not a guarantee that the subgrade will not lose moisture over time. Additional testing may be required to verify moisture content as determined by the Engineer.

8. Reworking a Section – When a section is reworked within 72 hours after completion of compaction, the Contractor shall rework the section to provide the required compaction. When a section is reworked more than 72 hours after completion of compaction, the Contractor shall add 25 percent of the specified percentage of lime.

E. TOLERANCES:

The following requirements shall apply to the finished lime stabilized subgrade:

1. Tolerance in Thickness – One measurement shall be taken at random locations by the geotechnical testing laboratory on center of roadway at 300 feet spacing along each roadway direction. When the measurement is not deficient by more than 0.5 inch from the plan thickness, full payment will be made. When such measurement is deficient more than 0.5 inch and not more than 1.0 inch from the plan thickness, two additional measurements shall be taken at random (typically, 25 feet either side of the deficient measurement) and used in determining the average thickness. When the average of the 3

[6] A field one point Proctor test shall be used to determine the maximum standard Proctor density unless a laboratory determined test is available which is of the same age as the lime-soil mixture.

measurements is not deficient by more than 0.5 inch from the plan thickness, full payment will be made. When the average thickness is deficient by more than 0.5 inch, the entire area shall be reprocessed at the Contractor's entire expense.

2. Strength Testing – The lime mixture must develop compressive strength of least 160 psi in 5 days at 100º F when tested in accordance with ASTM D 2166 or D 1633. NOTE: This testing is required, but will be used for information only.

F. QUALITY CONTROL:

The Engineer may periodically require tests by the geotechnical testing laboratory to assist him in evaluating the quality of work and Contractor performance. The Contractor shall assist the Engineer by excavating and backfilling shallow areas as necessary to take density tests.

Any constructed course which does not meet specification requirements shall be reworked, at the Contractor's entire expense, to bring that work within specification requirements. The Engineer's tests shall be used in evaluating whether project meets specification requirements. The following table provides minimum testing requirements:

TABLE 8.1 – MINIMUM MATERIALS SAMPLING AND TESTING FOR LIME STABILIZED SUBGRADE

TEST TYPE	TEST STANDARD	MINIMUM FREQUENCY OF TESTS
In-Place Soil Density and Moisture Content	ASTM D 698 ASTM D 1556 ASTM D 2167 ASTM D 2922 ASTM D 2216 ASTM D 3017	One test for every 300 feet spacing or less along each roadway direction, but no less than one test per day for each roadway subgrade
pH	Eades and Grim procedures ASTM D 2976	One test per 600 feet spacing or less along each roadway direction, but no less than test per day for each roadway subgrade
Thickness		One test for 300 feet spacing or less along each roadway direction, but no less than one test per day for each roadway subgrade
Compressive Strength	ASTM D 558 ASTM D 1633 ASTM D 2166	(a) One test for 900 feet spacing or less along each roadway direction, but no less than one test per day for each roadway subgrade, sealed and cured at 100 degrees F for 5 days (b) Strength not corrected for length/diameter.
Pulverization Testing	Tex-101-E, Part III	One test for every 600 feet spacing or less along each roadway direction, but no less than one test per day for each roadway subgrade
Swell Potential	ASTM D 4546	One test for every 900 feet spacing or less along each roadway direction, but no less than one test per day for each roadway subgrade

Note: The Engineer may test any other property of the materials or lime-soil mixture in this Item at intervals or occasions of his/her choosing.

G. METHOD OF MEASUREMENT:

The area of lime stabilized subgrade shall be measured by the square yards complete, in place and accepted. The quantity of lime accepted and used shall be measured by the ton.

H. BASIS OF PAYMENT:

Payment shall be made at the Contract unit price per square yard for the lime subgrade of the thickness specified. The price shall be full compensation for furnishing all material, except the lime and for all preparation of the subgrade material removed and replaced, proof rolling of secondary grade, delivering, placing, mixing, and compacting these materials, and all labor, equipment, tools and incidentals necessary to complete this item.

Payment shall be made at the Contract unit price per ton of lime used. This price shall be full compensation for furnishing this material; for all delivery, placing and incorporation of this material; and for all labor, equipment, tools, and incidentals necessary to complete this item. Stabilized subgrade found deficient in percentage of lime shall be paid for at an adjusted Contract Unit Price.

Payment will be made under:

Pay Item	Pay Unit
Lime Stabilized Subgrade	Square Yard
Quick Lime	Ton
Moisture Treated Subgrade (fill)	Cubic Yard
Moisture Treated Subgrade (cut or natural grade)	Cubic Yard